CLAIMS

What is claimed is:

1. A composite separator plate for a fuel cell comprising a body portion having a first surface with at least one flow channel formed therein, a second surface opposite said first surface, said body portion having a passageway formed through said plate between said first surface and said second surface and a plurality of electrically conductive elements, each of said plurality of electrically conductive elements having a first end terminating at said first surface and a second end terminating at said second surface such that said element extends continuously through said body in a through plane direction.

2. The composite separator plate of claim 1 wherein said body portion further comprises a polymeric material.

3. The composite separator plate of claim 2 wherein said polymeric material is a thermally conductive polymeric material.

4. The composite separator plate of claim 2 wherein said polymeric material is selected from the group consisting of thermoset polymers and thermoplastic polymers.

5. The composite separator plate of claim 4 wherein said polymeric material is selected from the group consisting of silicone, poly-isobutylene, epoxy, polyvinyl ester, polyester and phenolic.

6. The composite separator plate of claim 4 wherein said polymeric material is selected from the group consisting of polypropylene, ETFE, nylon and rubber-modified polypropylene.

7. The composite separator plate of claim 2 wherein said plurality of conductive elements are selected from the group consisting of carbon fibers, graphite fibers, Au-coated graphite fibers, Pt-coated graphite fibers, Au fibers, Pt fibers and stainless steel fibers.

8. The composite separator plate of claim 1 wherein said composite separator plate comprises a polymeric material of 50% to 99% by volume and conductive fibers of 1% to 50% by volume.

9. The composite separator plate of claim 1 wherein the cross-sectional area of each of said first and second ends comprise 5% to 50% of the surface area of said first and said second surfaces respectively.

10. The composite separator plate of claim 1 wherein said body portion further comprises a plurality of thermally polymer conductive particles.

11. The composite separator plate of claim 1 wherein said composite separator plate has a bulk resistivity less than 0.01 ohm • cm.

12. The composite separator plate of claim 1 wherein said composite separator plate has an area specific resistance less than 20 milliohms • cm^2.

13. The composite separator plate of claim 1 wherein said composite separator plate includes a layer of conductive material disposed over the first surface and in conduct with said plurality of conductive elements.

14. The composite separator plate of claim 13 wherein said layer of conductive material includes at least one material selected from the group consisting of gold, platinum, carbon, palladium, rhodium and ruthenium.

15. The composite separator plate of claim 1 wherein said second surface includes a plurality of flow channels formed therein.

16. A composite separator plate for use in a fuel cell stack, the composite separator plate comprising:

a plurality of elongated support members;

a body portion formed around the support members and having a first surface with a plurality of flow channels and a second surface opposite the first surface; and

a plurality of electrically conductive fibers disposed within the body portion, each conductive fiber extending continuously from the first surface of the body portion to the second surface of the polymeric body portion in a through plane orientation.

17. The composite separator plate of claim 16 wherein a thermally conductive member is disposed between each of said flow channels formed in the first surface.

18. The composite separator plate of claim 17 wherein said support members comprise thermally conductive members.

19. The composite separator plate of claim 18 wherein said thermally conductive members are operably coupled to a thermal management system to control the temperature of said composite separator plate.

20. The composite separator plate of claim 18 wherein said thermally conductive members further comprise tubular members.

21. The composite separator plate of claim 20 further comprising a heat sink extending from said thermally conductive tubular member and terminating at said first surface.

22. The composite separator plate of claim 20 wherein said tubular member comprises at least one material selected from the group consisting of carbon-loaded polymer, stainless steel, thermally-conductive polymer, carbon, titanium.

23. The composite separator plate of claim 16 wherein said plurality of fibers are thermally conductive.

24. The composite separator plate of claim 16 wherein said composite separator plate includes a layer of conductive material disposed over said first surface and in conduct with said plurality of fibers.

25. The composite separator plate of claim 24 wherein said layer of conductive material comprises at least one material is selected from the group consisting of gold, platinum, graphite, carbon, palladium, rhodium and ruthenium.

26. The composite separator plate of claim 16 wherein said second surface includes a plurality of flow channels formed therein.

27. A method of manufacturing a composite separator plate for a fuel cell, the method comprising the steps of:

arranging a plurality of elongated support members;

preparing a lattice having a plurality of elongated support member with a plurality of conductive continuous fibers interdisposed there between;

encasing the lattice in a polymeric material to form a separator plate;

forming a plurality of channels in a first surface of the separator plate;

removing a portion of the first surface of the separator plate to form a first exposed surface and to sever the plurality of continuous fibers into a plurality of filaments having a first end terminating at said first exposed surface;

removing a portion of a second surface of the separator plate to form a second exposed surface and to sever the plurality of filaments into a plurality of conductive elements having a second end terminating at the second exposed surface, each of the plurality of conductive elements extending continuously in a through plane direction from the first surface to the second surface.

28. The method of manufacturing a composite separator plate of claim 27 wherein said step of preparing a lattice includes the step of lacing the fibers through the support members.

29. The method of manufacturing a composite separator plate of claim 27 wherein said step of encasing the lattice includes locating the lattice in a mold cavity and injecting the polymeric material into the mold cavity.

30. The method of manufacturing a composite separator plate of claim 29 wherein the mold cavity includes a first molding surface having a plurality of land cavities for forming a plurality of channels in the first surface.

31. The method of manufacturing a composite separator plate of claim 27 wherein said steps of removing at least a portion of said first and second surfaces reduces the thickness of the body portion by at least 15%.

32. The method of manufacturing a composite separator plate of claim 27 wherein said steps of removing a portion of said first and second surface is performed by a machining operation.

33. The method of manufacturing a composite separator plate of claim 32 wherein said machining operation is selected from the group of machining operations consisting of laser machining, water-jet machining, milling, fly cutting and sanding.

34. The method of manufacturing a composite separator plate of claim 27 further including the step of applying an electrically conductive layer of material on the first exposed surfaces.

35. The method of manufacturing a composite separator plate of claim 27 further comprises the step of removing the elongated support member to provide a plurality of passages through the separator plate.

36. The method of manufacturing a composite separator plate of claim 27 wherein said steps of removing a portion of the first surface exposes a portion of the support member at said first exposed surface.

37. The method of manufacturing a composite separator plate of claim 27 further comprising the step of forming a plurality of channels in the second surface of the separator plate.